

ELECTRICAL ENGINEERING DESIGN AND CRITERIA

Electrical Engineering Design Criteria

1.0 Introduction

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and construction of electrical engineering systems for the Panoche Energy Center (PEC). More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement, and construction specifications as required by the California Energy Commission (CEC).

2.0 Codes and Standards

The design of the electrical systems, subsystem and components will be in accordance with the laws and regulations of the federal government, State of California, Fresno County, local agencies, and industry standards. The most current issue or revision of rules, regulations, codes, ordinances, and standards at the time of the filing of this Application for Certification (AFC) will apply, unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirement shall apply.

The following codes and standards are applicable to the electrical aspects of the power facility.

- American National Standards Institute (ANSI)
- American Society for Testing and Material (ASTM)
- Anti-Frication Bearing Manufacturers Association (AFBMA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- California Electrical Code (CEC)
- Nation Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

3.0 Switchyard and Transformers

3.1 Switchyard

The facility switchyard will be located on the northern portion of the site. It will be interconnected to Pacific Gas and Electric Company (PG&E) adjacent Panoche substation with overhead bare aerial cables. The switchyard will be of the air-insulated aluminum bus type and will consist of high voltage SF₆-insulated dead-tank circuit breakers arranged in a radial configuration. Connections to the nodes will be provided for each generator and for interconnecting to the utility grid. Each circuit breaker will be equipped with a no load break, air-insulated, disconnect switch on each side. Air-insulated aluminum strain bus will be used as the primary bus construction and interconnection material within the switchyard. The strain buses will be attached to strain insulators on structural steel H frame supports.

Current and voltage transformers will be located at points within the switchyard to provide for metering and relaying.

Control, protection and monitoring panel or devices for the switchyard will be located in the electrical building and generation control module. Monitoring and alarms will be available to the PLC operator workstations in the control room. The 125Vdc battery system will provide control and protection voltage to circuit breakers.

The switchyard design will meet the requirements of the National Electrical Safety Code-ANSI C2.

A grounding grid will be provided to control step and touch potentials in accordance with IEEE Standard 80, Safety in AC Substation Grounding. All equipment, structures and fencing will be connected to the grounding grid of buried bare copper conductors and ground rods, as required. The substation ground grid will be tied to the plant ground grid.

Lightning protection will be provided by shield wires and/or lightning masts for any overhead lines. The lightning protection system will be designed in accordance with IEEE 998 guidelines.

All electrical faults shall be detected, isolated, and cleared in a safe and coordinated manner as soon as practical to insure the safety of Equipment, Personnel, and the Public. Protective relaying will meet IEEE requirements and will be coordinated with PG&E's requirements.

The protection will be designed to maintain integrity when isolating a faulted node. Each circuit breaker will be provided with independent breaker failure relay protection scheme. Breaker failure protection will be accomplished by protective and timing relays for each breaker. Each 230kV circuit breaker will have 2 redundant trip coils.

Interface with PG&E's supervisory control and data acquisition (SCADA) system will be provided. Interface will be at the interface terminal box and RTU. Communication between the facility switchyard and the control building to which it is connected will be included.

3.2 Transformers

Each generator will be connected to the 230kV switchyard through a separate 230 – 13.8 kV, generator step-up transformer (GSU). The GSU will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.116. The transformers will be two-winding, delta-wye, ONAN/ONFA/ONFA cooling, and 65°C rises. The neutral point of the HV wye-connected winding will be solidly grounded. Each GSU will have metal oxide surge arrestors adjacent to the HV bushing terminals. The GSU's will have manual de-energized ("no-load") tap changers located in the HV windings.

Two of the four generators will be connected to the GSU's through low side generator breakers to allow taps for unit auxiliary transformers. The other two generators will be connected directly to respective GSU. The unit auxiliary transformers step the 13.8kV down to 4160V and connect

to 4160V switchgear via a non-segregated phase bus duct by way of main circuit breakers to supply the facility 4160V loads. A normally open tiebreaker between the two 4160V switchgear will allow a single unit auxiliary transformer so supply the entire facility load. The unit auxiliary transformer 4160V winding neutrals will be connected to ground grid through low impedance grounding resistors to limit system ground fault current.